ECOCYCLES
Scientific journal of the European Ecocycles Society
2018

Ecocycles 4(1): 10-15 (2018) **ISSN** 2416-2140
DOI: 10.19040/ecocycles.v4i1.87

AQUAPONIC CORNER

EU policies: New opportunities for aquaponics

Kyra Hoevenaars[1]*, Ranka Junge[2], Tamas Bardocz[1] and Matej Leskovec[1]

[1]AquaBioTech Limited, MST 1761 Mosta, Malta; [2]Institute for Natural Resource Sciences, ZHAW Zurich University of Applied Sciences, 8820 Waedenswil, Switzerland

E-mail of the corresponding author: kyh@aquabt.com

Abstract *– Aquaponics is a modern and sustainable food production technology. This paper reviews different policies relevant to aquaponics in order to create a clear picture on how aquaponics can contribute to achieving European goals and how the policies and strategies can provide support and opportunities for this sector. Because aquaponics falls into fish as well as plant production relevant policies are the Common Agriculture Policy and the Common Fisheries Policy, the European Union (EU) Food Safety and Nutrition Policy, and the EU Environmental Policy. Goals of these policies that are related to aquaponics include promoting innovation, increasing competitiveness and sustainability, improving access to space and water, welfare of fish, prevention of waste, and promoting resource-efficiency and low-carbon economy. Aquaponics contributes to achieving these goals by minimising water and nutrient use, utilising areas unfit for other food production systems, facilitating local food production and thus providing new business opportunities. The EU provides various frameworks for financial support for the different components of aquaponics, resulting in a range of opportunities for the newcomer as well as the already established aquaponics entrepreneurs. Financial support mostly targets research projects, while the sector also needs assistance in the commercial development.*

Keywords *– Agriculture, aquaculture, aquaponics, EU policy, fisheries*

Received: December 4, 2017 **Revised version received**: January 8, 2018 **Accepted**: February 3, 2018

Introduction

Aquaponics is an emerging technology combining aquaculture with soil-less plant cultivation (Somerville et al. 2014). Aquaponics offers an opportunity for environmentally sustainable food production, following the circular economy principles by reusing water and nutrients (Goddek et al. 2015). It allows food production on non-agricultural land or on other surfaces (such as rooftops), increases resource efficiency, and reduces waste compared to traditional farming practices. By locating farms close to markets or even in urban areas, food security and food systems resilience can be improved. Aquaponics also uses less inorganic fertilisers compared to hydroponics farms and instead uses fish metabolic wastes for vegetable production.

The aquaponic technology has been around since the 1970s (Naegel 1977), and a wide range of different systems have developed since (Junge et al. 2017). Because of the great variety of potential products, there are no specific regulations or specifically developed policies on the topic on a European level yet (Joly et al. 2015) and it is being discussed if a separate policy on aquaponics is necessary in the first place or if it can be included in an existing related policy.

So far, aquaponics falls under the common EU policies related to agriculture, fisheries, food safety and environment. Because aquaponics includes both fish and plant production, different policies apply. Like aquaculture operators, aquaponic producers use a shared primary resource (water) and generate effluents, and their activities are subject to a significant amount of policies and legislation (Joly et al. 2015). The development of aquaponics technologies is relatively new, and on top of this, it is often carried out in urban areas where different policies may apply than for activities in rural areas. There is an ongoing debate if aquaponics must involve hydroponic plant production or allows also the use of other substrates (Palm et al 2018). These difficulties so far prevent common EU policy and regulations specifically treating this production methodology. However, as a modern food production technology, aquaponics supports several development goals in different EU policies. The future of aquaponics is determined by the availability of natural resources and the market demand, both which can be influenced by policies and regulations.

This paper reviews different policies relevant to aquaponics to create a clear picture on how aquaponics can contribute to achieving EU goals and how the

policies and strategies can provide support and opportunities for this sector. The information provided can be used by national government bodies, lobbyists and farm associations to further promote and develop aquaponics activities in the future.

Policies related to aquaponics

The Common Fisheries Policy (CFP) and the Common Agriculture Policy (CAP) are both relevant for aquaponics, tackling the aquaculture and hydroponics components respectively (European Commission 2012, European Commission 2013). Policies on food safety, animal health and welfare, plant health, and the environment (waste and water) also apply (Table 1).

Part of the CAP is the Rural Development Policy, also referred to as the second pillar of CAP, which focuses on increasing competitiveness and promoting innovation (Ragonnaud 2017). Each Member State has at least one rural development programme. Most countries have set goals to provide training, restructure and modernise existing farms, set up new farms and reduce emissions. Measures against excessive use of inorganic fertilisers were introduced in the CAP and environmental policies and are regulated through the EU's Nitrates Directive (Directive 91/676/EEC 1991) and the Water Framework Directive (WDF). The goal of the WFD is to protect the ecological and chemical status of surface waters and quantitative status of groundwater bodies (European Union 2016).

The CAP so far does not include support for urban

Table 1: Overview of EU policies and strategies applicable to the sector including the topics relevant to aquaponics.

Policy/Strategy	Relevant topics	Reference
Common Agriculture Policy (CAP) - Rural Development Policy	– Provide training, restructure and modernise existing farms, set up new farms and reduce emissions – Closing the cycles of organic waste, water and nutrients – Promote knowledge transfer and innovation in agriculture – Increase competitiveness of agriculture – Animal welfare – Measures against excessive use of inorganic fertilisers	CAP reform 2014-2020 (European Union 2013, Ragonnaud 2017, Massot 2017)
Common Fisheries Policy (CFP) - Strategic guidelines for the sustainable development of EU aquaculture	– Improve access to space and water – Increase competitiveness of aquaculture – Implementation of the Water Framework Directive in relation to sustainable aquaculture	CFP reform 2014-2020- Com (2013) 229 Final (European Commission 2013)
EU Food Safety and nutrition policy	– New food chain technologies; increase in productivity from other primary production technologies	https://europa.eu/european-union/topics/food-safety_en
EU platform on animal welfare-strategy for the protection and welfare of animals	– Welfare of farmed fish	EU Animal welfare strategy 2012-2015 (European Union 2012)
EU Environmental policy	– Resource-efficient, green, and competitive low-carbon economy – Make cities more sustainable	The 7th Environment Action programme (EAP) (European Union 2014)
Strategy on the prevention and recycling of waste	– Prevention of waste is the priority, followed by reuse, recycling, recovery and disposal	SEC (2011) 70 Final (European commission 2011)

agriculture, and the Rural Development Policy is solely focused on rural areas (Curry et al. 2015). There are also no other existing policies specifically covering urban food production.

The CFP reform and the strategic guidelines for the sustainable development of EU aquaculture were issued by the Commission to assist EU countries and stakeholders to tackle challenges that the sector is facing. It emphasises on the sustainable development of the aquaculture sector and facilitates the implementation of the WFD in relation to sustainable aquaculture (European Commission, 2013).

The CFP requires the development of a Multiannual National Strategic Plan in each Member State to develop strategies to promote and develop the aquaculture sector (European Commission 2016). Taking account to their different historical developments and cultivated species, each member state can support the existing but also develop new technologies, such as aquaponics. This should lead to an increase in production and thus reduce the dependence on imports. Main actions planned by Member States are simplification of administrative procedures, coordinated spatial planning, enhancing competitiveness, and promoting research and development.

In the framework of the CFP, an Aquaculture Advisory Council (AAC) has been established. The main objective of the AAC is to provide advice and recommendations to the European institutions and the Member States on issues related to the sustainable development of the aquaculture sector (Sheil 2013).

The goal of the food safety policy of the EU is to ensure safe and nutritious food from healthy animals and plants while supporting the food industry (European Commission 2014b). The integrated Food Safety policy also includes animal welfare and plant health. In the strategy for animal welfare there is an action on the welfare of farmed fish, however, there are no specific rules in place (European Commission 2012).

Environmental impacts of aquaculture are regulated under a range of EU legal requirements including water quality, biodiversity and pollution. Environmental policies relevant for aquaponic operators are the Strategy on the prevention and recycling of waste (European Commission 2011) and the 7th Environment Action Programme (EAP) under the EU Environmental Policy (European Union 2014).
None of these EU policies and guidelines so far explicitly mentions aquaponics. According to DG MARE, regulations on aquaponics need to be resolved within the individual Member States (COST Action FA1305 2017), e.g. involving action resulting from the respective National Strategic Plans.

Aquaponics contributes to goals in EU policies and strategies

An objective in both CFP and CAP is to increase competitiveness and sustainability of aquaculture and agriculture respectively (Massot 2017). One of the goals in the CFP is exploiting competitive advantage by obtaining high quality, health and environmental standards.

Aquaponics can contribute to the developmental goals mentioned in these policies (Table 1), with the main factors being the reduction of water use and reducing waste from fish production by nutrient recycling. Discharged water is converted into a resource and solid wastes can be upgraded as plant fertilizers. Because modern aquaponics is based on recirculating aquaculture systems, these operations are relatively independent of the location and can contribute to regional food production and value chains even in urban areas. Open aquaculture systems have constraints like water resource use, pollution, localised reduction in benthic biodiversity, significant dredging of water bodies and physical modification of land, changes in water flow and introduction of alien species (European Union 2016). In aquaponics, however, most of these pressures are mitigated. Compared to hydroponics systems, aquaponics reduces the use of mineral, often non-sustainably mined, fertilisers.

One of the priorities in the strategy on aquaculture is to improve access to space and water (European Commission 2013). Competition among different stakeholders and often strict environmental rules limit the further development of open aquaculture systems inside the EU. Aquaponics systems can be located almost anywhere, including deserts, degraded soil and salty, sandy islands, since it is a closed-loop using a minimum of water. Therefore, it can utilise space that is not suitable for other food production systems, like rooftops, abandoned industrial sites and generally non-arable or contaminated land. Since aquaponics reuses 90-95% of the water, it relies much less on water availability compared to other systems like open aquaculture, hydroponics, and irrigation agriculture.

Larger commercial aquaponics systems have a high level of biosecurity and environmental conditions can be fully controlled ensuring a healthy environment for the fish, thus minimising the risk for diseases and parasite outbreaks. Because of the higher control on production, losses are lower, which can provide aquaponic farmers with a competitive advantage over traditional farmers. On the other hand, using one nitrogen source to culture two products (Somerville et al. 2014), increases the investment risk as both fish and plant production must be maximised in order to make profit. However, if this is done successfully, combined with the positive view on more ecologically produced products in Western markets, high revenues can be achieved (Somerville et al. 2014).

Policy objectives also include promoting productivity using innovative technologies. Aquaponics is seen as an innovative production system. Within aquaponics there is a variety of technologies available (Thorarinsdottir 2015). For both Recirculating Aquaculture Systems and hydroponics systems, a variety of technologies are currently in use and customisable to the environmental conditions and requirements of the systems (Somerville et al. 2014).

An objective in the strategy on the Prevention and Recycling of waste (European Commission 2011) includes introducing life-cycle thinking, looking at the environmental impacts. It mentions that the prevention of waste is the priority, followed by reuse, recycling, recovery and last disposal. Also, one of the priority areas in the 7th EAP, targets to transform the EU into a resource-efficient, low-carbon economy with a special focus on using waste as a resource (European Union 2014). Aquaponics systems create little waste. The water in aquaponics systems is recirculated, thus waste water is minimised. By using the fish process water for plant nutrition, organic waste from aquaculture is reused in the hydroponics component of the aquaponics system. The solid waste produced in an aquaponics system can be mineralised and returned to the system or utilised as compost for soil agriculture. Aquaponics also promotes local food production, thereby minimising transport costs. Lastly, placing aquaponics farms in urban settings it can provide ecological and social added value in cities and play a role in adaptation to climate change.

EU support

The EU has a positive opinion towards the benefits of aquaponics (Joly et al. 2015). An analysis of the European parliamentary Research service listed aquaponics as one of the ten technologies which could change our lives (Van Woensel and Archer, 2015). In the report on technological solutions for sustainable agriculture in the EU (McIntyre 2016), aquaponics is mentioned as a research and funding priority. In the amended budget for 2014, it is stated that aquaponics is considered as a new revolution in food production (European Commission 2014a).

The CAP is undergoing a reform targeted to be fit for 2020 onwards. One aspect of this reform is to increase production by using less resources and to generate a higher yield. Therefore, the Commission is proposing to double the budget for agricultural research and innovation, including a new European Innovation Partnership (European Union 2012). This may be also beneficial for aquaponics operators.

Because aquaponics combines aquaculture and agriculture and can be located in urban areas, different policies apply. This can be beneficial for aquaponics projects since more funding schemes are available implementing the different policies (focus on plants and use fish effluent as nutrient source or focus on fish and use hydroponics as waste treatment) focusing on reducing environmental impact in aquaculture and agriculture. On the other hand, it can enhance difficulties in obtaining funding for aquaponics. This technology can fall between the chairs, when only one part (either aquaculture or hydroponics) can be funded, because the funding scheme focuses either on fisheries/aquaculture or agriculture. This has already been a major hurdle for SMEs investing in this technology. Another problem is that it is not clear to the Member States under which sector aquaponics falls. This in some cases results in no funding of aquaponics projects at all since government personnel fear it is not eligible. This led to a most recent revision of aquaponics definition and nomenclature, enabling the authorities, customers, producers, and all other stakeholders to distinguish between the various systems, to better understand their potentials and constraints, and to set priorities for business and regulations (Palm et al. 2018).

The Seventh Framework Programme (under the Multiannual Financial Framework of the European Commission) funded a couple of projects related to aquaponics, the most relevant one called INAPRO (Innovative model and demonstration based water management for resource efficiency in integrated multitrophic agriculture and aquaculture systems) carried out by 17 partners from 7 countries. INAPRO aimed at improving current approaches to rural and urban aquaponics through the development of a model and the integration of innovative technologies to save water, energy and nutrients (http://www.inapro-project.eu). The EU Framework Programme Horizon 2020 (challenge 2 'Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bioeconomy' and challenge 5 'Climate action, environment, resource efficiency and raw materials), provides funding to several aquaponic initiatives, like EASY, CoolFarm and ECOFISH. Because of the innovative nature and the necessity to improve the available technologies, it is expected that funding for research will be made available by the Member States (Van Woensel and Archer 2015).

Other possible funding opportunities under the Multiannual Financial Framework of the European Commission for aquaponic development projects are the European Innovation Partnership "Agricultural Productivity and Sustainability" (EIP-AGRI), "A long term EU-Africa research and innovation partnership on food and nutrition security and sustainable agriculture" (LEAP-AGRI), the SME-instrument, the Partnership on Research and Innovation in the Mediterranean Area (PRIMA) initiative under ERANET MED and the European Maritime and Fisheries Fund (EMFF). The EMFF can support research institutions and universities as well as companies, however requires different rates of co-funding.

The EU, through the Horizon 2020 programme, also supported the COST (European Cooperation in Science and Technology) Action FA1305 "The EU Aquaponics Hub: Realising Sustainable Integrated Fish and Vegetable Production for the EU" to promote innovation and capacity building by a network of researchers and commercial aquaponics companies. Several participants of the COST Action participated in a workshop in Brussels with DG MARE, DG AGRI and DG RTD in order to communicate the status quo of aquaponics in Europe and to explore avenues to support its development in order to fulfil its potential to become a significant part of a sustainable food production strategy for the EU. DG AGRI recognises that aquaponic production has numerous benefits and can be considered more sustainable than conventional agriculture. DG Mare works with the individual Member States to identify bottlenecks and implement regulations and will raise this issue at their next technical seminar (COST Action FA1305 2017).

Conclusion

Even though there is no explicit EU framework for aquaponics, aquaponics, as an innovative agricultural system, can contribute to many priorities set through the EU policies and strategies. The EU support through financial measures is assisting the development of the technology further. However, this mostly targets research projects, while the sector also needs assistance in the commercial development through support of proof of concept projects. As a matter of fact, there are so far very few successful commercial aquaponics systems operating in the EU. Currently, there might not be a necessity for an aquaponics policy, however, recognising and covering the technology in existing policies will be beneficial for the development of the sector.

Acknowledgements

The authors would like to acknowledge the contribution of COST Action FA1305. They would also like to thank COST member Agnès Joly (France) for her contribution.

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